

its sediments of the thoroughly characteristic pottery of the youngest (the iron culture) of the south tumulus.

(4) After this, and apparently contemporaneous with the founding of Anau, irrigation began through which the plain was raised 15 feet, bringing it to its present condition, in which the north tumulus stands embedded to a depth of 27 feet, the south tumulus to the depth of 22 feet, and Anau to 15 feet.

EFFECT OF SOUND ON WATER JETS.¹

THE structure of water jets was first investigated by M. Savart, who in 1833 published a series of beautiful papers in the *Annales de Chimie et de Physique*. Since then it has received the attention of many experimenters, notably M. Plateau and Prof. Magnus, while of later years

connecting ligament, which separates and forms a smaller drop (Fig. 1). If the jet is falling freely, and subject only to accidental tremors and disturbances, the formation of drops is by no means regular, and the sizes and shapes of the drops vary much. If a vibrating tuning fork be held in contact with the stand, and if the pressure of water and the diameter of the orifice be suitable, the jet will appear like a vibrating string, a succession of nodes and loops being formed. The effect of the tuning fork is to render the separation of the drops regular, a drop being cast off with each vibration of the fork. If the jet be falling vertically, as the drop leaves the end of the clear column it is extended in a horizontal direction, but as it falls it oscillates about the spherical form, being alternately elongated and compressed under the action of the surface tension of the liquid (Fig. 2).

Prof. Magnus explained that the wavy appearance of the jet under the action of the tuning fork was due to all the drops which arrive at any given point of space being in the same phase; at the middle of a swelling they are most elongated horizontally, and midway between the broadest portions of two consecutive swellings they are most elongated vertically.

These remarks apply to a jet of water about 2 mm. in diameter. If the diameter of the jet be much less than 1 mm., swellings are not produced in it. The effect of a tuning fork is to render the drops practically equidistant and uniform in size (Fig. 3). If a fine jet be projected upwards (Fig. 4) it will be seen to consist of irregular drops, while the effect of a tuning fork upon it is often to cause it to break up into several distinct streams (Fig. 5).

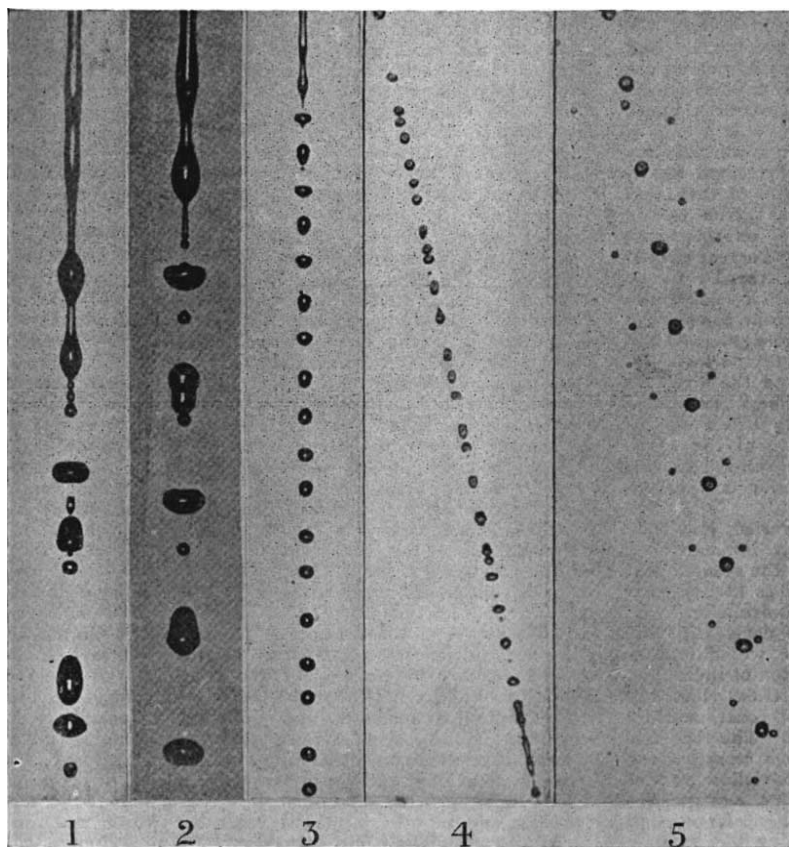


FIG. 1.—Some Instantaneous Photographs of Water Jets.

our knowledge of the subject has been much added to by the observations and mathematical researches of Lord Rayleigh. The older experimenters had to content themselves with observing the jet through a revolving disc with radial slots, but by means of an electric spark and rapid plates we can now secure photographs of the jet at any desired instant. The eye shows us that a jet of water consists of two parts, (1) a clear column, and (2) a troubled portion. The spark reveals to us that the troubled portion, though apparently continuous, is really a succession of drops, which move too rapidly for the eye to perceive them as such while under continuous illumination.

Towards the lower part of the clear column of water the jet presents alternate swellings and contractions, and at the very extremity a drop is cast off, leaving behind a

can be shown not only physiologically, but also by certain test-tube reactions, that the proteids and proteoses are different in the different venoms.

Thus the blood serum of an animal that has been injected with cobra venom causes a precipitate when mixed with an aqueous solution of cobra venom, but has no such action when mixed with a solution of the venom of the Australian tiger snake. As regards the venom of the banded krait (*Bungarus fasciatus*), with which this memoir deals, Captain Lamb's researches show that cases of poisoning may be divided into three classes:—(1) those in which after a large dose rapid death follows from the occurrence of extensive blood coagulation in the blood vessels; (2) those which are fatal after two or three days, and present acute

THE POISON OF THE BANDED KRAIT.¹

THERE is an unbounded field in India for the study of the venoms of the many species of poisonous snakes met with in that country, and the Government of India has been well advised to devote to this subject certain of its scientific memoirs now being issued from time to time. Captain Lamb, I.M.S., the author of the one under review, has already done good work in this branch of research.

The venoms of various snakes, though all composed of the same class of chemical substances (coagulable proteids and proteoses) in varying proportion, differ markedly in their physiological actions, and it

¹ "The Structure of Water Jets, and the Effect of Sound thereon." By Philip E. Belas, Royal College of Science, Dublin. With photographs. Abstract of paper read before the Royal Dublin Society on March 15.

¹ Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 7, 1904. "Some Observations on the Poison of the Banded Krait (*Bungarus fasciatus*). By Captain George Lamb, M.D., I.M.S. (Calcutta: Government Printing Office, 1904)

nervous symptoms; and (3) those which run a chronic course and end fatally between the sixth and twelfth days after poisoning. In these, histological examination shows a well marked primary degeneration of the cells of the central nervous system, and to this the fatal issue is due.

The venom of the krait was found to be much less toxic than that of the cobra or of the daboia, and, unlike the former, has only a slightly destructive action on the red blood corpuscles. It, however, markedly increases blood coagulability, and may cause extensive intravascular clotting. Cobra and tiger snake anti-sera possess no neutralising action for the krait venom. The use of anti-sera, the only efficient antidotes for snake bites, must, therefore, unfortunately be limited, for it is necessary to have an anti-serum for the venom of every species. R. T. HEWLETT.

CURRENTS AROUND THE COASTS OF NEWFOUNDLAND.¹

IN the course of the investigations described by Dr. Bell Dawson, a number of points were met with which are of general interest, as they probably characterise the currents on the margin of any large or oceanic area under similar conditions.

The currents in the above regions were examined last season from May to September, under the personal supervision of Dr. Dawson, the engineer in charge of the Tidal and Current Survey. Special attention was given to the question of indraught into the larger bays on the south coast, and to the behaviour of the Polar current which follows the eastern coast. For this work, the *D. G. S. Gulnare* was equipped with appliances for deep sea anchorage, and apparatus of a modern type, in some ways specially devised for the purpose. At anchorages carefully chosen, which were made in all depths up to 100 fathoms, the speed of the currents was measured, and the direction noted every half hour, day and night. The observations also included the under-current, the density and temperature of the water, the mileage and direction of the wind, and a continuous record of the tide on a self-registering gauge placed in a harbour in the region, for comparison with the set of the current.

The behaviour of these currents is very varied, and they were found to be so weak as to be readily influenced by the wind; but by a systematic reduction of the results, Dr. Dawson has prepared a report which describes the currents as concisely as possible, while avoiding technicalities. The report is divided into two parts; the first deals with the currents met with on the steamship route, which follows the south coast for 180 miles, and the question of indraught into the larger bays; and the second part describes the character of the Polar current on the east coast, and its possible change of direction when disturbed. The report is illustrated by nine diagrams and maps, which represent the results graphically. From this report, the following descriptions and explanations are culled, which are of general interest from a hydrographic point of view. References to the local geography are omitted as far as possible, as they might be inconvenient to follow without the map which accompanies the report.

Nature of the Currents.—The currents were almost invariably less than one knot. As a rule, they veered widely and were irregular in direction; and with so low a speed they were readily influenced by the wind. There were three elements to distinguish:—(1) Any general tendency to set in one direction more than in others. (2) Any tidal influence, which might show itself either as a marked change in the direction of the set, or as a period in which a variation in velocity would recur. (3) The influence of the wind in disturbing the usual behaviour of the current. From the observation, the effect of any storms which occur during the summer season seldom extends to a greater depth than 5 or 10 fathoms; and it was therefore found that the behaviour of the under-current at 15 to 30 fathoms afforded a most valuable indication of the normal character of the current. In these currents, the tidal element is almost invariably present in some form, more or less

distinct; and this is almost always combined with a tendency to make on the whole in some one direction. It is not therefore possible to maintain an arbitrary distinction between "constant currents" and "tidal streams"; but the only natural distinction is to use the term *current* for all horizontal movements of the water, and *tide* for the vertical movement from high to low water.

The following features in these currents will be interesting for comparison with the behaviour of currents elsewhere, on the open coast of the ocean:—(1) When more than five miles from shore, there are no currents at any time throughout the season which exceed one knot in any direction. The only exception to this is the Polar current, in which a maximum speed of 1.15 knots was observed. (2) On the south coast, when within four or five miles of the shore, the current is chiefly governed by the tide, and sets in the two opposite directions alternately; but the farther out the point of observation, the greater the tendency for the direction of the current to veer completely around the compass. (3) The Polar current sets very constantly to the south-west, for a width of thirty or forty miles off the eastern coast. During times of disturbance, it may set south-eastward, or even be reversed, on the surface. When such disturbance occurs, it is usually for part of a day immediately before a gale comes on.

In the Polar current the influence of the tide was distinctly marked by a fluctuation in velocity, the current being 24 per cent. stronger during flood tide on the average. The under-current had the same general direction as the surface current. It set constantly to the south-westward, even at times when the current on the surface was most disturbed by the wind, judging from numerous observations at 40 fathoms, or about one-half the total depth of the water. The fluctuation in velocity with the tide was even more marked in the under-current than on the surface. During the flood tide, the strength from 15 to 40 fathoms was unusually constant, and at 40 fathoms it was always as strong and often stronger than on the surface. During the ebb tide it slackened below, as it did on the surface, and was usually weaker at the greater depths. When slackest, at about half-ebb, it fell below one-fourth of its greatest strength during flood tide, but even then the movement was distinctly felt to a depth of 60 and 75 fathoms.

Off the south shore, at an anchorage at an offing of seventeen miles, the behaviour of the current was very variable. During a period of nine days in June, when 158 hours of continuous observations were secured, a variety of weather conditions obtained, although the wind did not ever exceed twenty-one miles an hour. To understand the nature of the current, careful comparisons with the tides and winds are undoubtedly required; but the continuity of observations, taken every half hour day and night, affords a good basis for the comparison, and with an anemometer on board, the wind observations are much better obtained than by comparison with an observatory on shore.

The most evident change in the behaviour of the current is that sometimes the direction veers completely round the compass, and at other times it veers backwards and forwards between limiting directions. This change is evidently due to the variation in the amount of tidal influence with the springs and neaps. The veer completely around the compass occurs at neap tides, this being well marked at the moon's quarters on two different occasions. The veer is then continuously to the right, and the period in which a complete revolution occurs is just about sixteen hours. This period is quite definite, as deduced from six complete revolutions which were observed. It appears to result from a combination of the tidal period with a general movement of the water to the westward. This appears to be the only possible explanation, in accordance with the principles of rotary movement. This sixteen-hour period has been met with at other stations during the season, as well as in other regions in former years. At other times in the month, when the tidal influence is stronger, the current veers to the right and left through a range which varies from eight points to half a circumference. The complete period in which it veers and backs is from ten to fourteen hours. It is not impossible that this veer would be found to correspond with the tidal period if an average were taken which would be sufficiently long to eliminate other disturbing causes. On the other hand, at

¹ "The Currents on the South-eastern Coasts of Newfoundland. From Investigations of the Tidal and Current Survey in the Season of 1903." By Dr. W. Bell Dawson.